PART II. RECOVERY

RECOVERY OBJECTIVE

The objective of this recovery plan is to perpetuate viable metapopulations (VPs) and large viable metapopulations (LPs) of the Karner blue butterfly in the major physiographic, vegetational and climatic regions, henceforth called "recovery units" (refer to APPENDIX B**,** Figures B1-B4) throughout the range of the butterfly. This would allow reclassification and ultimately removal of this species from the Federal list of "Endangered and Threatened Wildlife and Plants" (50 CFR 17.11 and 17.12). The Karner blue butterfly may be considered for reclassification to threatened status and ultimately delisting when the recovery criteria outlined below are met. It is estimated that full recovery of the species will take about 20 years.

Reclassification Criteria

Criterion 1

Establish VPs and LPs of Karner blues in 13 recovery units (RUs) as specified in Table 4 (refer to "Reclassification" column).

Criterion 2

Each VP shall have:

1. a management and monitoring plan to be implemented into the future, that will include:

    a. suitable buffering of the metapopulation against adverse disturbance and threats to survival,

    b. maintenance of a diverse and appropriate successional array of suitable Karner blue habitat (refer to APPENDIX G), and

    c. identification of appropriate responses to potential metapopulation declines; and

2. a sufficient number of individuals in an appropriate metapopulation structure, maintained for at least 5 years after the implementation of the management plan. The number of individuals shall be at least 3,000 first or second brood adults in the final year of evaluation and in four of the five years overall. In all years, the number of adults shall be greater than 1,500 in one of either the first or second brood. In some circumstances the 3,000 level may be too high or too low (refer to APPENDIX E).

The management and monitoring systems and the buffering capacity and structure of the metapopulation are all linked. Refer to APPENDICES G and H.

Table 4. Metapopulation goals by recovery unit for the Karner blue butterfly.

Recovery Unit (RU) (refer to APPENDIX B)	State	Recovery Goals[1]	
		Reclassification	Delisting
Merrimack/Nashua River System	NH	1VP[2]	1VP[2]
Glacial Lake Albany	NY	3VP	3VP
Ionia	MI	2VP	2VP or 1LP
Allegan	MI	2VP	1VP + 1LP
Newaygo	MI	2VP	1VP + 1LP
Muskegon	MI	2VP	2LP
Indiana Dunes	IN	3VP	3VP
Morainal Sands	WI	1LP[3]	2LP or 2VP + 1LP[3]
Glacial Lake Wisconsin	WI	2VP + 2LP	2LP + 2VP west of river[4] + 1VP east of river[4]
West Central Driftless	WI	1VP + 3LP	1VP + 3LP
Wisconsin Escarpment and Sandstone Plateau	WI	1VP	1LP
Superior Outwash	WI	2VP	2VP or 1LP
Paleozoic Plateau	MN	2VP or 1LP	2VP or 1LP

Notes:

[1] The attainment of these recovery goals should not be strongly influenced by whether a subpopulation near a boundary of a RU is in or out of the RU. Subpopulations near or on the boundary of a RU can count towards recovery in that RU. Subpopulations near or on the boundary between two RUs can count towards recovery in either, but not both RUs.

[2] VP = (minimum) VP
LP = large VP

[3] One of the LPs required in the Morainal Sands RU that is anticipated to include the Emmons/Welch complex should be evaluated in 5 years to document progress to increase the area of suitable habitat and to reevaluate the potential of the area to support a LP.

[4] The Wisconsin River.

Each LP shall have in addition to Criterion 2:

3. a larger areal extent and more suitable habitat than required for a minimum VP, specifically:

    a. an areal extent of at least 10 square miles (10 mi^2), in which at least 10 percent of the area has suitable habitat (i.e., an equivalent of at least 640 acres of suitable habitat in a 10 square mile area);

    b. the suitable habitat is distributed over two-thirds of the 10 square mile area.

4. a more robust metapopulation structure with larger numbers of individuals than a VP, specifically:

    a. connectivity between sites so that the average nearest-neighbor distance between sites is 1 kilometer (0.62 miles), with a minimum distance of 200 meters (219 yards), and a maximum distance of 2 kilometers (1.24 miles);

    b. at least 6,000 adult butterflies maintained for at least 5 years after implementation of the management plan. At least 6,000 first or second brood adults shall be present in the final year of evaluation and in 4 of the 5 years overall;

5. reduced monitoring and management requirements compared to those required for a VP (refer to APPENDIX F)

Delisting Criteria

Criterion 1

Establish VPs and LPs of Karner blues in 13 RUs as specified in Table 4 (refer to "Delisting" column).

Criterion 2

Same as Criterion 2 above for reclassification with the addition that each VP shall be demonstrably self-reproducing, shall be maintained at or above minimum allowable population sizes, and shall be managed and monitored under the specified management and monitoring plans for at least 10 consecutive years.

Refer to APPENDIX B, Table B1 for potential locations of metapopulation centers across the species range.

The above noted reclassification and delisting criteria are preliminary, and may be revised on the basis of new information (including research noted in the recovery tasks).

RATIONALE

Management of a Viable Metapopulation (Refer also to APPENDIX G)

Purpose

Management is essential to maintain the metapopulation, to respond in the event that the metapopulation begins to decline, and to buffer the metapopulation from the influences of various sources of environmental variation that could adversely affect the metapopulation. Thus, a management plan must specify how each of these three functions will be met.

Specificity

A management plan shall be developed for each metapopulation that is required in Criterion 1 for reclassification and delisting or both.

Management risks

If a metapopulation is a minimum VP, there is little room for management error, and the management system must use methods that have been proven to have a beneficial effect on Karner blue metapopulations and do not put any part of the metapopulation at risk of long term reduction. If the metapopulation is larger than the minimum, then more experimental management can be encouraged to provide the evidence to justify reducing the costs of maintaining the viable population. A metapopulation is large enough to allow experimental management if it can reasonably be anticipated that failure of the management experiment to maintain Karner blue will not result in a total population less than a minimum VP. In those parts of Wisconsin and Michigan where the Karner blue butterfly is abundant and suitable habitat is spatially extensive, greater management risks are allowable.

Management strategy

Management shall maintain the minimum VP by maintaining an appropriately disturbed habitat mosaic and facilitating the use of suitable habitat by the Karner blue. The mosaic shall be managed so that suitable habitat does not decline in total area or in the number of suitable habitat sites, and so that the degree of connectivity among occupied and occupiable sites is maintained. A shifting mosaic of suitable habitat may be appropriate in many cases, allowing annual variation in the area of suitable habitat. Management practices shall be designed and implemented to renew suitable habitat at appropriate rates. If the renewal rate is too low, habitat will deteriorate (for example, by succession), eliminating Karner blues from sites; and if it is too high, then local Karner blue subpopulations may have insufficient time to recover from the disturbance. Refer to APPENDIX G for more specific management guidelines.

Monitoring of a Viable Metapopulation (Refer to APPENDIX H)

Purpose

The monitoring system of a viable metapopulation shall provide (1) timely information on any decline in the metapopulation or the habitat mosaic, and (2) information on the status of the metapopulation, its associated habitat and the potential adverse disturbances and threats to survival. Monitoring shall be frequent and precise enough so that declines or reductions can be detected in enough time that improvements to management can be implemented.

Specificity

A monitoring system shall be developed for each metapopulation that is required in Criterion 1 for reclassification, delisting, or both.

Use of information

A decision framework for how the information from the monitoring activities will be used in making management decisions shall be specified. Action triggers, such as a decline in the metapopulation or an adverse change in the habitat mosaic, shall be identified and the changes in management action that must be implemented consequent to the action trigger shall be specified. Communication and implementation routes must be clarified so that management practices can be modified and modifications can be implemented in a timely manner if the action triggers are reached.

Monitoring strategy

Monitoring shall occur frequently during the initial period of maintaining a viable metapopulation. It may be relaxed as confidence accrues that the management system does maintain the metapopulation and habitat mosaic above that needed for a minimum VP. It shall be increased in frequency if new threats to the metapopulation are identified. A minimum VP shall be monitored intensively. If the metapopulation is greater than the minimum, then monitoring may be less intensive. Refer to APPENDIX H for specific monitoring requirements and guidelines for minimum VP and LPs.

Buffering Capacity (Refer to APPENDIX G)

Specificity

The buffering capacity of a viable metapopulation shall be evaluated for each metapopulation that is required in Criterion 1 for reclassification, delisting, or both. There is no ideal habitat or habitat mosaic that buffers against all adverse disturbances and threats to survival.

Identification of adverse disturbances and threats to survival

All actual and potential local and large-scale adverse disturbances and threats to survival shall be identified for each viable population. Such disturbances include natural and anthropogenic disturbances, including, but not limited to, unusual weather, storms, wildfire, and land use policy and practices. Not all disturbances will be detrimental to all metapopulations. Some threats include development of habitat for alternate uses (residential, commercial, road building, or other uses), conservation plans and road and power line maintenance plans that do not consider Karner blue, herbicides that harm lupine, insecticides, succession, and, inappropriate or excessive prescribed fires.

Need to mitigate adverse disturbances and threats

Mitigation strategies for all identified adverse disturbances and threats shall be developed and implemented. Identified adverse disturbances and threats may be mitigated by the management system, the monitoring decision framework, or by the structure of the metapopulation.

Population Structure (Refer to APPENDIX E)

Components of metapopulation structure

There are minimum structural thresholds below which a metapopulation is unlikely to be viable, even with substantial management and monitoring. These thresholds will involve a combination of the following five structural characteristics: total metapopulation size (number of butterflies), number of subpopulations, size of the subpopulations (number of butterflies in the subpopulations), connectivity of the subpopulations, and the diversity and quality of the array of suitable habitat.

Redundancy

All metapopulations must have more than one subpopulation. Because the best management plan may have design flaws, and errors in implementation can occur, and because of the threat of large-scale catastrophic disturbance, it is necessary and desirable to maintain a larger metapopulation than would be necessary in a risk-free, constant environment. More research is necessary to show that a VP could be maintained on a single site.

Necessary metapopulation structure

A VP shall have:

1. At least 3,000 first or second brood adults in the entire metapopulation. The 3,000 number may be too low to define a VP if, for example, the buffering capacity of the supporting habitat is insufficient, resulting in large population fluctuations. It may be above the actual minimum number required for

viability if, for example, the metapopulation is well buffered against environmental variation.

2. All subpopulations within 1 kilometer (0.62 miles) of another subpopulation, if there are no dispersal corridors and no dispersal barriers. If there are dispersal corridors, then subpopulations shall be within 2 kilometers (1.24 miles) of another subpopulation following the path of the dispersal corridors. If significant dispersal barriers are present, shorter dispersal distances are needed. If the total metapopulation size is larger, then the degree of connectivity can be less.

3. Although there may be essential minimum area requirements for a minimum VP, these requirements cannot be specified without additional research.

Specificity

The minimum criteria for metapopulation structure are specified in very broad terms. The metapopulation structure that is necessary to maintain a viable population may not be the same in different metapopulations because it will depend on the management and monitoring systems, the details of metapopulation structure, and the buffering capacity of the metapopulation. Consequently, the metapopulation structure that is necessary to maintain a viable metapopulation should be specified for each population

Occupancy of sites

A metapopulation may be specified with geographically fixed subpopulation sites, such as in metapopulations where potential suitable habitat is not abundant. All of these sites and associated subpopulations can be identified as essential for the maintenance of the viable metapopulation, whether they are occupied or occupiable sites.

STEPDOWN RECOVERY OUTLINE

1. Protect and manage the Karner blue and its habitat to perpetuate viable metapopulations of Karner blue butterflies.

    1.1. Monitor population trends, habitat and distribution in RUs and search for new populations/occupied habitats in unsurveyed areas.

        1.11. New Hampshire
        1.12. Minnesota
        1.13. Michigan
        1.14. New York
        1.15. Indiana
        1.16. Wisconsin

    1.2. Continue/start management activities for all metapopulations in RUs.

        1.21. New Hampshire
        1.22. Minnesota
        1.23. New York
        1.24. Michigan
        1.25. Indiana
        1.26. Wisconsin

    1.3. Develop and implement protection and management plans for metapopulations within RUs and integrate into management operations

        1.31. Develop a management and monitoring plan for each metapopulation that addresses all recovery metapopulation criteria detailed in PART II, RECOVERY OBJECTIVE.

            1.311. Minnesota
            1.312. New York
            1.313. Indiana
            1.314. Michigan
            1.315. Wisconsin
            1.316. New Hampshire

        1.32. Implement the management and monitoring program for each metapopulation in the RU.

            1.321. Implement the management plan.

                1.321.1. New Hampshire
                1.321.2. Minnesota
                1.321.3. New York

1.321.4. Wisconsin
1.321.5. Indiana
1.321.6. Michigan

1.322. Implement strategies to guarantee the long-term availability of the geographic land base for the viable metapopulations.

1.322.1. New Hampshire
1.322.2. New York
1.322.3. Indiana
1.322.4. Michigan
1.322.5. Wisconsin
1.322.6. Minnesota

1.323. Implement the monitoring plans.

1.323.1. New Hampshire
1.323.2. Minnesota
1.323.3. New York
1.323.4. Indiana
1.323.5. Michigan
1.323.6. Wisconsin

1.4. Protect existing Karner blue butterfly populations.

1.41. Review Federal, state and private activities.

1.411. Section 7 Federal responsibilities
1.412. Section 10(a)(1)(A) scientific permits
1.413. Section 10(a)(1)(B) incidental take permits

1.42. Develop standardized conditions for scientific permits
1.43. Identify mechanisms to streamline the Federal permit process for private landowners

1.5. Develop recovery implementation strategies to promote recovery.

2. Evaluate and implement translocation where appropriate.

2.1. Develop protocols and guidelines for translocation.

2.11. Develop protocols, guidelines and selection criteria for translocation.
2.12. Incorporate research findings on captive propagation into protocols.

2.2. Implement reintroduction or augmentation.

2.21. Initiate/continue captive rearing/augmentation.

2.211. New Hampshire
2.212. Minnesota
2.213. New York
2.214. Other sites as need develops

2.22. Initiate captive propagation.

2.221. New Hampshire
2.222. Other sites as need develops

2.23. Consider reintroduction if necessary.

3. Develop rangewide and regional management guidelines.

3.1. Continue development of Karner blue butterfly Forest Management Guidelines.
3.2. Develop guidelines for protection of Karner blue from biocides.
3.3. Continue development of Karner blue Management Guidelines.
3.4. Continue development of standardized monitoring protocols for Karner blue butterflies.

4. Develop and implement information and education program.

4.1. Develop outreach material on Karner blue life history and conservation.
4.2. Inform local and county governments of Karner blue RUs.
4.3. Encourage private landowners to conserve the Karner blue butterfly.
4.4. Assess the needs, goals, and outcomes for public outreach.

5. Collect important ecological data on the Karner blue and associated habitats.

5.1. Priority 1 research

5.11. Habitat management relative to the Karner blue
5.12. Methods development for Karner blue captive propagation
5.13. Lupine propagation
5.14. Karner blue translocation methods
5.15. Alternative habitat restoration methods
5.16. Remote sensing
5.17. Glacial Lake Albany RU metapopulation decline

5.2. Priority 2 research

5.21. Karner blue dispersal
5.22. Dispersal corridors and barriers
5.23. Ecosystem management
5.24. Karner blue monitoring
5.25. Forest management research

5.26. Highly dispersed metapopulations

5.3. Priority 3 research

5.31. Ecology of local populations
5.32. Effects of human activities
5.33. Browse threshold
5.34. Re-establishment of lupine
5.35. Population structure

6. Review and track recovery progress.

6.1. Develop a clearinghouse for Karner blue data, progress reports, metapopulation plans, HCPs, guidance documents, and other relevant information.
6.2. Conduct Recovery Team meetings on an annual basis to evaluate progress.
6.3. Revise plan as appropriate at five-year intervals.
6.4. Hold periodic meetings to promote information sharing.

Note: Refer to APPENDIX B, Table B-1 for potential locations of metapopulation centers across the species range.

RECOVERY TASKS

1. Protect and manage the Karner blue butterfly and its habitat to perpetuate viable metapopulations of Karner blue butterflies.

Many Karner blue butterfly metapopulations are currently vulnerable to short-term decline, and interim protection, management and monitoring measures are required to maintain and/or stabilize them until more comprehensive site-specific metapopulation management plans can be developed and implemented.

1.1 Monitor population trends, habitat and distribution in RUs with imperiled metapopulations, and search for new populations and occupied habitat in unsurveyed areas.

Because some Karner blue metapopulations are imperiled, and because it may take several years to implement successful long-term management and monitoring plans interim monitoring of these imperiled metapopulations is essential. Interim monitoring will provide the timely information required to adjust habitat management and protection activities over the next few years, ensuring that Karner blue populations do not decline before recovery activities can be fully implemented.

The full extent of some metapopulations in Wisconsin and Michigan is not known. Additional surveys will be required before effective metapopulation recovery plans can be developed and implemented.

1.11 New Hampshire

This population survives at such a precarious state that monitoring of both flights provides important information for interim management strategies. This intensive monitoring will be essential into the foreseeable future.

1.12 Minnesota

The two populations at the Whitewater Wildlife Management Area (WMA) are at such a precarious state that monitoring of both flights and determining how butterflies use the ongoing restoration experiments is necessary to make management decisions. This intensive monitoring will be essential into the foreseeable future.

1.13 Michigan

There is no comprehensive monitoring strategy in place that predicts current population trends. The distribution of the Karner blue in the Newago RU is poorly known. Additional butterfly surveys on public and

private lands will be required before an adequate strategy for protecting Karner blue in this RU can be developed.

Ongoing inventory and monitoring work is essential within the Muskegon RU to determine near-term trends in Karner blue populations and to determine the extent of Karner blue distribution within the landscape.

1.14 New York

The downward trend in numbers and occupancy of habitat of most populations in the Glacial Lake Albany RU must be carefully monitored. Many existing sites are under intense pressure to be converted to incompatible uses, and protection of suitable sites, whose occupancy status is unknown, is frequently challenged. Declining habitat quality must be documented to motivate the need for active management. Unknown populations must be located and protected.

1.15 Indiana

Ongoing monitoring of the West Gary metapopulation is essential to determine near-term trends of Karner blue populations. Most of the habitat is fire-suppressed and requires brush removal. The two metapopulations in the IDNL are not as precarious, but annual monitoring is still required.

1.16 Wisconsin

Monitoring of the Yellow River Focus Area adjacent to the east boundary of Necedah NWR located in the Glacial Lake Wisconsin RU is needed to determine if Karner blue populations exist and to assess whether they can contribute to achieving the recovery goals of this RU.

1.2 Continue/start management activities for all metapopulations in RUs.

Karner blue metapopulation persistence is under immediate threat in some RUs, mainly due to poor habitat quality. Immediate implementation of efforts to counter these threats is necessary. These preliminary management efforts will be a positive first step towards stabilizing the metapopulations and implementing longer-term management to maintain viable metapopulations.

1.21 New Hampshire

Because of the precarious state of the Concord Karner blue population, intensive habitat improvement and expansion is necessary including lupine and nectar source enhancement through artificial planting and seeding. Although lupine is relatively abundant at the Main Site and the Concord

Airport site, it is sparse at the Service's Great Bay NWR conservation easement (Easement). Newly established lupine plants must be protected from herbivores. Nectar availability is a limiting factor for Karner blues at the Main and the Airport sites, especially during dry summers.

Habitat management to control woody encroachment at the Main Site is also needed in the short-term by working closely with the Public Service of New Hampshire and private landowners to (mechanically) manage vegetation. Other management needs include mechanical vegetation management and controlled burns to improve habitat at the Service easement and at the Concord Airport, monitoring of the mowing regime of the safeways at the airport, and working with the City to adjust the timing and height of mowing as appropriate.

1.22 Minnesota

Continued small- and large-scale experimental habitat restoration, which is recommended in the Whitewater WMA Management Plan, is critical for increasing this population which is at low levels and could decline further. On-going restoration projects should continue, especially those near occupied sites and additional restoration activities conducted as needed based on these results. Accelerated dispersal of adults should continue to create an additional occupied site in what appears to be high quality, but unoccupied habitat.

1.23 New York

All of the Karner blue metapopulations in New York require intensive habitat improvement to upgrade habitat quality. Most sites are not under management and may become unsuitable for Karner blues in the next few years, thus leading to possible extirpation of the species at some sites.

In the Albany Pine Bush Preserve (Preserve) metapopulation, four subpopulation sites have been managed for Karner blues. In 1998, the parking lot between the southern and northern parts of the Apollo Drive subpopulation was removed and the site was planted with lupine and nectar species. The southern part of the Apollo Drive subpopulation has been acquired by the Preserve Commission; however, the much larger number of butterflies in the northern part requires protection from use and habitat management. The only other subpopulation on Preserve land, the Willow Street Powerline, is managed by Niagara Mohawk and the Preserve Commission to remove woody species (although until 1998 removal was very limited). The subpopulation at the Crossgates Mall (including both the Hill and Powerline section) continues to be intensively managed through removal of invasive vegetation and planting of desirable species. Lupine and nectar plants were established in Fort Hunter

Powerline (the only subpopulation site in Schenectady County) and should be monitored and maintained. Management is needed at all other subpopulation sites to prevent their loss, to expand the sites, and to develop needed dispersal corridors.

The Saratoga Sandplains metapopulation has been severely reduced because of the loss of sites or conversion to land uses incompatible with Karner blue butterflies. Management efforts by the Wilton Wildlife Preserve and Park, The Nature Conservancy (TNC), and private landowners is crucial in preserving, managing and enlarging the remaining clusters of Karner blue subpopulations in the heart of the area. Until recently, actual management has been limited. Attempts to re-establish nectar species at key sites should continue, and all sites should be managed for Karner blues as needed and possible. Large-scale improvement projects should be conducted when more land is brought under management capability, either through acquisition or agreements, and more funding becomes available.

In the Saratoga West metapopulation site, both the Saratoga Spa State Park and the Saratoga Airport have agreements for mowing which should be maintained. However, active improvement of habitat has been limited in the past. Intensive efforts to increase lupine and nectar at the airport and state park have only begun during the past two years. A third site has recently become part of a village park, and although a management plan for the habitat has not been worked out yet, permission for needed habitat improvements has been given and should be conducted. All other sites are in need of management to preclude loss due to habitat succession.

1.24 Michigan

Habitat improvement work is essential within the RU in Michigan. In the Ionia RU (Flat River SGA), management to secure the metapopulation from threats from ORV use and rights-of-way management needs to be implemented. The Newaygo and Muskegon RUs will require protection from ORV use and commercial and residential development. Habitat improvement work will include increased connectivity between sites and improvement of individual sites to assure Karner blue survival until a comprehensive plan is developed.

1.25 Indiana

Rapid expansion and improvement of Karner blue habitat for the West Gary metapopulation is a critical first step towards stabilizing downward population trends at this site. Ongoing habitat restoration at Ivanhoe dune and swale will provide additional buffering from catastrophic events as well as larger Karner blue populations. These interim actions will help assure Karner blue survival until a long-term, comprehensive management

and monitoring plan can be developed and implemented. Habitat management work required in the Service's Biological Opinion for the Karner blue at IDNL should continue.

1.26 Wisconsin

Habitat restoration, enhancement and/or management activities are needed on all properties where Federal recovery efforts are focused. Ongoing barrens management activities on state [e.g., Sandhill Wildlife Area (WA), Glacial Lake Grantsburg (Crex Meadows and Fish Lake WAs), Black River State Forest, Emmons Creek State Fisheries Area], Federal (Necedah NWR, Fort McCoy), and private properties (Mr. Bob Welch, TNC) are already occurring and expected to continue (refer also to 1.315).

1.3 Develop and implement management and monitoring plans for metapopulations within RUs and integrate into ongoing management operations.

Each metapopulation must be deemed viable as defined in PART II, RECOVERY OBJECTIVE of this Plan. In addition to its traditional biological connotations, the term viable as used here for Karner blue butterflies includes long-term mechanisms for management and monitoring of butterflies and their habitat as integral components of viability. In many cases, such as when Federal- or state-managed lands are essential to recovery; the plans can be integrated into existing plans for public land management.

1.31 Develop a management and monitoring plan for each metapopulation that addresses all recovery metapopulation criteria detailed in PART II , RECOVERY OBJECTIVE.

No two Karner blue metapopulations will be the same, therefore approaches to ensuring metapopulation viability in each area will be different. Yet the principles guiding the design and management decisions are the same at every site, and revolve around balancing the extirpation/recolonization equation. Local factors and conditions must be incorporated into decisions concerning Karner blue recovery. For example, the history of previous habitat management, conversion, and fragmentation constrain current options. Other management objectives, such as forestry or agriculture production, native ecosystem recovery, and preserving other rare or endangered species, may or may not be entirely compatible with efforts that maximize Karner blue metapopulations. These other objectives must be integrated into the management and monitoring plan. Not every acre must be dedicated and managed for the benefit of the Karner blue, yet those acres that are, must be well chosen and managed in light of the specific needs of the butterfly and its supporting ecosystem. No one management unit is likely to satisfy all management objectives, but every site should attempt to satisfy as many as possible within real world ecological, sociological and financial

constraints. Refer to the recovery criteria and APPENDICES G and H for guidance on development of management and monitoring plans.

1.311 Minnesota

Paleozoic Plateau RU

Modify existing Karner blue butterfly management and monitoring plan for the Whitewater WMA (Lane 1994c) to incorporate recovery criteria necessary to meet the recovery objectives for this RU and to preclude loss of subpopulations which are at risk due to low numbers.

1.312 New York

Glacial Lake Albany RU

Incorporate Federal and state recovery guidance for the Karner blue butterfly and its support habitats into the existing preserve design for the Albany Pine Bush Preserve (Albany Pine Bush Preserve Commission 1993). Incorporate recovery guidance into the existing Site Conservation Plan for the Saratoga Sandplains Macrosite (Pickering 1994), and develop into a metapopulation management plan by incorporating Federal and state recovery team viability criteria and by involving local government (Town of Wilton and Saratoga County) and non-governmental organizations in the formulation of the plan. Develop a preserve design for the Saratoga West metapopulation through involvement of the state recovery team, local government (Towns of Milton and Saratoga Springs, City of Saratoga Springs, and Saratoga County) and non-governmental organizations. Through involvement in the state recovery planning process, encourage incorporation of protection designs and management strategies into local municipality planning projects.

1.313 Indiana

Indiana Dunes RU

Modify existing management plans to incorporate recovery criteria necessary to meet recovery goals for IDNL. Develop recovery plan for the West Gary site, inclusive of existing Lake County Parks Natural Areas, and TNC holdings and adjacent private landowner stewardship plans.

1.314 Michigan

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals. Evaluate permit options and develop procedures to cover multiple take activities on multiple sites resulting from management activities of the Karner blue butterfly.

Allegan RU

Modify existing management plans for Allegan SGA.

Ionia RU

Modify existing management plans for Flat River SGA and adjacent private lands.

Muskegon RU

Modify existing management plans for Huron-Manistee NF and adjacent private landowner stewardship plans.

Newago RU

Modify existing management plans for Huron-Manistee NF and adjacent private landowner stewardship plans.

1.315 Wisconsin

State property planning will be done via DNR-HCP implementation and state master planning.

Morainal Sands RU

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals for properties within the Emmons/Welch complex which include Emmons Creek State Fishery Area, Hartman Creek State Park, National Park Services' Ice Age Trail segment, and privately owned "Welch" forest crop law stand. In addition, develop protection agreement with Mr. Welch for Sawyer Prairie, and with other private landowners in this complex as needed and available. Incorporate recovery guidance into management and/or master plans for Greenwood and White River Marsh WAs. Pursue State Natural Area designation of state lands.

Glacial Lake Wisconsin RU

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals for (1) Meadow Valley WA (via the ITP for the Wisconsin Statewide HCP, section 7 consultation for this federally owned property, and DNR Master Planning), (2) Necedah NWR (via section 7 consultation process), (3) Sandhill State WA (via the ITP for the HCP), and (4) Quincy Bluff Natural Area (via the ITP for the HCP). Incorporate recovery guidance for the Karner blue into conservation measures for the Air National Guard Hardwood Range (Hardwood Range) via section 7 consultation. Because Hardwood Range site is not large enough to support a VP, explore development of a partnership between Hardwood Range, Wood, and Juneau County's Forest and Parks Departments, and Necedah NWR (relative to the Yellow River Focus Area) to formulate a plan to manage and monitor a VP in this portion of the RU.

West Central Driftless RU

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals for (1) Black River State Forest (via the ITP for the Statewide HCP), (2) Jackson County Forest (via the ITP for the Statewide HCP plus additional commitments as needed), (3) Fort McCoy Military Reservation (via section 7 consultation process), and (4) Monroe County Forest (via section 7 on DOD-leased lands and possibly through the ITP for the HCP with additional commitments).

Wisconsin Escarpment and Sandstone Plateau RU

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals for Eau Claire and Clark County Forests (obtain county board approval), with possible assistance from area utilities, who are involved in the Wisconsin Statewide HCP, and Eau Claire and Clark County Highway Commissions.

Superior Outwash RU

Modify existing management and/or master plans to incorporate recovery criteria necessary to meet recovery goals for (1) Glacial Lake Grantsburg (Crex Meadows and Fish Lake State WAs), combined with Governor Knowles State Forest (via the ITP for the HCP), with possible assistance on Burnett County Forest (via the ITP for the HCP as well as other commitments as needed).

1.316 New Hampshire: Merrimack/Nashua River Systems RU

Modify existing Karner blue butterfly management and monitoring plans to incorporate recovery criteria and guidance necessary to meet recovery goals for this RU. This will entail reviewing and amending as necessary, the Concord Pine Barrens Preserve Design, the Concord Airport and Service Easement Plans, and the management plan for the Main Sites.

1.32 Implement the management and monitoring plan for each metapopulation in the RU.

1.321 Implement the management plan.

Metapopulation-specific management plans must be implemented in ways to ensure that management will persist into the indefinite future if populations are to qualify as VPs.

1.321.1 New Hampshire

Merrimack/Nashua River Systems RU

It is crucial to maintain existing habitat and restore degraded habitats for the Karner blue at Concord due to the declining and precarious nature of the population.

1.321.2 Minnesota

Paleozoic Plateau RU

Restore habitat and create fire breaks to expand and protect populations which are at risk of decline due to low numbers at the Whitewater WMA.

1.321.3 New York

Glacial Lake Albany RU Pine Bush Preserve

Maintain and restore Karner blue habitat according to the modified Pine Bush Preserve Plan to expand and improve habitat quality. Restore connectivity between subpopulations through appropriate habitat management. Coordinate habitat management between the Preserve Commission and private land managers to enhance metapopulation health and function.

Saratoga Sandplains

Maintain and restore habitat according to the modified Saratoga Sandplains management plan. Enhance metapopulation connectivity with appropriate habitat management. Coordinate management among managers of lands protected for the Karner blue, municipalities and private landowners.

Saratoga West

Maintain and restore habitat according to the newly developed Saratoga West management plan. Enhance metapopulation connectivity with appropriate habitat management. Coordinate management among managers of lands protected for the Karner blue, municipalities and private landowners.

1.321.4 Wisconsin

Morainal Sands RU

(1) Emmons/Welch complex: Enhance connectivity between subpopulations and expand openings via appropriate management. Minimize affects from public use, including mountain bikes along Ice Age Trail through habitat areas.

(2) Greenwood Wildlife Area: Continue prairie/savanna restoration efforts via appropriate management.

(3) White River Marsh Wildlife Area: Begin restoration of additional potentially suitable habitat that surrounds smaller core areas.

Glacial Lake Wisconsin RU

(1) Meadow Valley WA: Establish barrens restoration and management project, working as necessary with Necedah NWR to complement its efforts on adjoining lands. Incorporate results of barrens management into management activities at this site and Sandhill State WA using adaptive management principles.

(2) Necedah NWR: Continue barrens restoration and management efforts across property, and maintain appropriate disturbance regime. Evaluate effects of various disturbance techniques in progress and incorporate results using adaptive management principles.

(3) Air National Guard Hardwood Range: Develop and maintain appropriate disturbance regime, establish firebreaks where needed and enhance habitat as needed.

(4) Sandhill State WA: Continue habitat restoration and maintenance efforts. Delay mowing of County Highway X until after September.

(5) Quincy Bluff Wetland Preserve: Begin barrens restoration efforts, augmented with lupine propagation and/or Karner blue translocation/reintroduction if necessary.

West Central Driftless RU

(1) Black River State Forest/Jackson County Forest: Maintain positive disturbance regime via wildlife management and silvicultural practices throughout Indian Grave Creek Barrens Complex and Dike 17 complex, using permanent core populations at designated areas and trails and roads as corridors to extent possible. Develop connectivity between those populations around Dike 17 refuge and those north of Highway 54 in Staffon and Cemetery Road areas. Delay mowing along occupied and connecting roadsides until after September.

(2) Fort McCoy: Maintain positive disturbance regimes through military, silvicultural, and wildlife practices to establish and maintain two LPs (one each on the North and South Post), and to conserve Karner blues south of State Highway 16. Establish connectivity between the North Post LP and Habelman Road area of Black River State Forest south of I-94 compatible with military operations.

(3) Monroe County Forest: Maintain positive disturbance regime compatible with military

operations on DOD-leased lands as needed to enhance populations at Fort McCoy.

Wisconsin Escarpment and Sandstone Plateau RU

Maintain positive disturbance regime via silvicultural and wildlife management practices throughout Coon Fork–South Fork–Canoe Landing complex. Designate permanent core population areas and use trails and roads as connecting corridors to extent possible.

Superior Outwash RU

Continue barrens restoration and maintenance efforts at Crex Meadows and Fish Lake WAs, plus the Kohler-Peet Barrens area on Governor Knowles State Forest. Explore connectivity between Crex Reed Lake Barrens and Kohler Peet Barrens via management on intervening County Forest lands. Explore enhancement and connectivity via various rights-of-way managers such as Northwestern Wisconsin Electric Co. (HCP Partner), Burnett County Highway Department, and various municipalities.

1.321.5 Indiana

Indiana Dunes RU

Restore habitat on public (including IDNL) and private lands to expand/improve Karner blue habitat quality. Restore connectivity in West Gary by restoring fire suppressed habitat remnants. Coordinate habitat management activities between state, private and Federal managers to enhance Karner blue metapopulation function/health.

1.321.6 Michigan

Allegan RU

Maintain existing habitat and restore suitable habitats for the Karner blue on public and private land in the RU. Maintain sufficient habitat to meet the metapopulation objectives. Continue barrens restoration projects within the RU with emphasis on connectivity between subpopulations, expansion of existing sites, and enhancement of habitat attributes within sites. This may be done by a number of

different methods (e.g., cutting, brush hogging or burning). Landscape-scale burns may be desirable where ownership and site management allows.

Ionia RU

Maintain existing habitat and restore suitable habitats for the Karner blue on public and private land in the RU. Maintain sufficient habitat to meet the metapopulation objectives. Continue barrens restoration projects within the RU with emphasis on connectivity between subpopulations, expansion of existing sites, and enhancement of habitat attributes within sites. This may be done by a number of different methods (e.g., cutting, brush hogging or burning). Landscape-scale burns may be desirable where ownership and site management allows.

Muskegon RU

Maintain existing habitat and restore suitable habitats for the Karner blue on public and private land in the RU. Maintain sufficient habitat to meet the metapopulation objectives. Continue barrens restoration projects within the RU with emphasis on connectivity between subpopulations, expansion of existing sites, and enhancement of habitat attributes within sites. This may be done by a number of different methods (e.g., cutting, brush hogging or burning). Landscape-scale burns may be desirable where ownership and site management allows.

Newago RU

Maintain existing habitat and restore suitable habitats for the Karner blue on public and private lands in the RU. Maintain sufficient Karner blues to meet the metapopulation objectives. Protection from ORV and development is needed. Prairie and barrens restoration projects should continue through cutting, nectar and lupine propagation and burning.

1.322 Implement strategies to guarantee the long-term availability of the geographic land base for the viable metapopulations.

In all RU except the Paleozoic Plateau RU in Minnesota, it will be necessary to guarantee the long-term availability of the geographic land base of each viable metapopulation. Most plans will identify important Karner blue habitat areas which need to be available

long-term. This might be accomplished by land acquisition, conservation easements, management agreements, HCPs, or other means. These efforts should be taken in a timely fashion. A brief review of land protection needs are described in Task 1.322.1 through Task 1.322.6.

1.322.1 New Hampshire

Merrimack/Nashua River Systems RU

An informal management agreement currently exists with the electrical utility company that manages vegetation at the Main Site; obtain a formal management agreement or conservation easement for the Main Site. Monitor City of Concord and Federal Aviation Administration implementation of Concord Airport Master Plan Update (City of Concord 1996), review proposals for new construction and facility improvements, recommend locations and project designs that minimize loss of Karner blue habitat. Manage/restrict ORV use at the Main Site and Service Easement. Work with City of Concord to implement the management agreement for the Airport.

1.322.2 New York

Land acquisition is needed in the Albany Pine Bush, Saratoga Sandplains and Saratoga West metapopulation areas. Conservation easements and other protection will be needed at all three areas. Private landowner cooperation regarding ORV use and prescribed burning will be especially important. Establish a cooperative protection and management entity for the Saratoga West area (the management entity for Saratoga Sandplains is the Wilton Wildlife Preserve and Park). Work with the state, city, town, and private landowners in and near the Albany Pine Bush, Saratoga Sandplains, and Saratoga West metapopulation sites to include Karner blue preserve design concepts into local planning to facilitate restoration of one metapopulation in each area.

1.322.3 Indiana

Indiana Dunes RU

Land acquisition is needed in the West Gary population. Habitat protection is expected at the West Gary population site and both metapopulations associated with the IDNL.

1.322.4 Michigan

Allegan RU

Promote long-term, cost efficient management strategies and work with private landowners to develop cooperative management agreements that minimize loss of Karner blue habitat. Maintain regular contact with utilities that manage rights-of-way on the Allegan SGA to update management agreements.

Ionia RU

Develop strategies to manage/restrict ORV use on Flat River SGA. Maintain regular contact with utilities that manage rights-of-way on the Flat River SGA to update management agreements.

Muskegon RU

Habitat protection within the metapopulation, especially in areas threatened by development, is expected in the Huron-Manistee NF boundary. Land acquisition may be considered if the lands are necessary for recovery and other agreements are inadequate to ensure recovery.

Newago RU

Habitat protection within the metapopulation, especially in areas threatened by development, is expected in the Huron-Manistee NF boundary. Land acquisition may be considered if the lands are necessary for recovery, and other agreements are inadequate to ensure recovery.

1.322.5 Wisconsin

Morainal Sands RU

Consider designation of Emmons Creek/Hartman Creek State Park and Ice Age Trail complex as State Natural Areas; pursue conservation easement or other permanent protection with private owners in the complex.

Glacial Lake Wisconsin RU

If Karner blue sites in the Yellow River Focus Area are necessary to establish a viable metapopulation in this RU, land agreements should be explored to insure long-term maintenance of these sites. Land acquisition may be considered from willing landowners if the sites in the Yellow River Focus Areas are necessary for recovery and other agreements are inadequate to ensure recovery.

West Central Driftless RU

Consider designation of Indian Grave Creek Barrens as State Natural Area.

1.322.6 Minnesota

Paleozoic Plateau RU

Coordinate and implement recovery activities at the Whitewater Wildlife Management Area.

1.323 Implement the monitoring plans

Because monitoring is included as a key component of Karner blue metapopulation viability, implementation of an appropriate monitoring plan is essential. As explained in PART II, RATIONALE, Monitoring of a Viable Metapopulation, monitoring programs should be designed to provide essential feed back to managers so that the effectiveness of management can be evaluated and management can be adapted. Consequently, the monitoring protocol will likely be slightly different for each metapopulation.

1.323.1 New Hampshire

Merrimack/Nashua River System RU

Implement the monitoring plan. Track the phenology, numerical abundance and extent of habitat utilized by first and second brood Karner blue butterflies at the three subunits (Main Site, Easement and Airport) in this RU.

1.323.2 Minnesota

Paleozoic Plateau RU

Implement the monitoring plan. Monitor Karner blue populations, habitat and habitat occupancy as recovery and habitat restoration activities are implemented.

1.323.3 New York

Glacial Lake Albany RU

Implement the monitoring plan. Monitor Karner blue populations, habitat and habitat occupancy as recovery and habitat restoration activities are implemented. Coordinate monitoring on public and private lands.

1.323.4 Indiana

Indiana Dunes RU

Implement the monitoring plan. Monitor Karner blue populations, habitat and habitat occupancy as recovery and habitat restoration activities are implemented. Coordinate monitoring on public and private lands.

1.323.5 Michigan

Allegan RU

Implement the monitoring plan. Monitor Karner blue populations, habitat and habitat occupancy as recovery and habitat activities are implemented. Coordinate monitoring on public and private lands. Ensure monitoring protocol is reliable and efficient across extensive acreage.

Ionia RU

Implement the monitoring plan. Monitor Karner blue populations, habitat and habitat occupancy while recovery and habitat restoration activities are implemented.

Muskegon RU

Implement the monitoring plan. Coordinate monitoring efforts to meet criteria for viable population objectives. Ensure monitoring protocol is efficient, accomplishable, reliable, and portrays population trends for metapopulations.

Newago RU

Implement the monitoring plan. Coordinate monitoring efforts to meet criteria for viable population objectives. Ensure monitoring protocol is efficient, accomplishable, reliable, and portrays population trends for metapopulations.

1.323.6 Wisconsin

In all RUs, implement the respective monitoring plans. Coordinate recovery monitoring efforts with those developed for the statewide HCP to avoid duplication of effort. Ensure monitoring protocol is efficient and doable across extensive acreage involved. This may require a modified monitoring protocol involving sampling of habitats for Wisconsin.

4 Protect existing Karner blue populations

1.41 Review Federal, state and private activities

Federal, state and private activities that may affect the habitat or result in the taking of Karner blue butterflies should be reviewed to the extent possible under Federal and state law. Appropriate measures should be taken to protect the butterfly and its habitat due to proposed activities. The States of New Hampshire, New York, Michigan, Minnesota, and Ohio have regulations regarding the potential of Karner blues. Although the Karner blue is not listed in Wisconsin, it is a species of Special Concern and the WDNR, through a cooperative agreement with the Service is committed to furthering the conservation and recovery of the species (refer

to PART I, CONSERVATION MEASURES, State Protection). Three Federal regulatory review processes are discussed below.

1.411 Section 7 Federal responsibilities

Under section 7(a)(1) of the Act, Federal agencies are directed to utilize their programs to conserve threatened and endangered species. Section 7(a)(2) requires Federal agencies to consult with the Service to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of listed species, nor destroy or adversely modify critical habitat (no critical habitat has been designated for the Karner blue butterfly). Federal programs and consultations with the Service should strive to implement recovery goals for the Karner blue butterfly to the maximum extent possible.

Formal section 7 consultations for the Karner blue butterfly have taken place for projects in Wisconsin, Michigan, and Indiana.

Consultations are expected to continue in all states with occupied Karner blue habitat, with the greatest number of them taking place in Wisconsin and Michigan which support the majority of butterfly sites. Refer to PART I, CONSERVATION MEASURES, Federal Regulatory Protection, Section 7 consultation for overview of consultation activities.

1.412 Section 10(a)(1)(A) scientific permits

Scientific permits under section 10(a)(1)(A) of the Act are issued by the Service to researchers for scientific purposes or to enhance the propagation or survival of the listed species. They also can be used to authorize take of the butterfly for management activities that contribute to the survival of the species. Due to the intense interest in research pertaining to the Karner blue butterfly, the Service has issued several scientific permits in the past, and anticipates issuing more in the future to address still unanswered research needs, management and recovery questions. Research permit applications should be well thought out, designed to minimize harm to the species, and reviewed by appropriate experts to ensure meaningful results. Scientific permits may also be used to encourage Safe Harbor approaches to conservation of the Karner blue butterfly. Refer to PART I, CONSERVATION MEASURES, Federal Regulatory Protection, Federal permits for further information on research permits, and the Safe Harbor approach to conservation.

1.413 Section 10(a)(1)(B) incidental take permits

Section 10(a)(1)(B) of the Act provides for the issuance of "incidental take" permits for the take of federally-listed animals such as the Karner blue butterfly for actions not authorized, funded or carried out by Federal agencies (see 1.411 above); namely, most state, county, municipal and privately owned lands. Applicants for an incidental take permit must develop a habitat conservation plan (HCP), and except for low-effect HCPs, must also develop an accompanying NEPA document. The Service has currently issued two "incidental take" permits involving the Karner blue. The first to the Town of Rome (Adams County), Wisconsin, and the second to the Wisconsin DNR for the Wisconsin Statewide HCP for the Karner Blue Butterfly (refer to PART I, CONSERVATION MEASURES, Federal Regulatory Protection, Federal permits).

1.42 Develop standardized conditions for scientific permits

To expedite the processing of section 10(a)(1)(A) scientific permits (refer to 1.412 above), and to ensure uniformity of data rangewide, standardized permit conditions should be developed and provided to Service and state offices that may be involved in Karner blue butterfly scientific permit activities.

1.43 Identify mechanisms to streamline the Federal permit process for private landowners

Presence of an endangered species on private lands can result in additional costs and concerns for the landowner, especially in relation to the future value and use of the property. Because all "take" of a listed species must be authorized via a Service permit, streamlining the permit process could address some of these private landowners concerns. In addition, streamlining these procedures might encourage private landowners to participate in recovery (private landowners cannot be mandated to recover federally listed species).

Streamlined regulatory approaches to authorize "take" of the Karner blue butterfly include use of low-effect incidental take permits on an individual landowner basis, and programmatic, regional, or statewide incidental take permits (USFWS and NMFS 1996) that include a strategy to cover private landowners. The Wisconsin Statewide HCP for the Karner blue butterfly includes a participation strategy that covers "incidental take" for a select group of private landowners and provides a mechanism to extend permit coverage to new partners in the conservation program, thereby not only

streamlining the permit process but eliminating it for some private landowners.

Another tool offered by the Service to encourage private landowner participation in conservation and recovery of listed species that can be considered is the Safe Harbor Agreement (refer to PART I, CONSERVATION MEASURES, Federal Regulatory Protection, Federal permits).

1.5 Develop recovery implementation strategies to promote recovery

It is important to encourage public participation in implementation of recovery actions. Participation strategies/plans should be developed as appropriate that provide a framework for recovery. Members to this process should include representatives of all interested parties that could be affected by implementation of the recovery actions and/or could assist with recovery, including Federal and state agencies, and private landowners (e.g., companies, private citizens and conservation groups). Education and outreach activities (refer to Task 4. Develop and implement information and education program below) may provide a vital link for involving important stakeholders in development of recovery strategies, especially in recovery areas that include or affect private lands. Karner blue butterfly state working groups should consider serving as leads for these efforts.

The New York State Working Group is developing a state recovery plan which provides a general recovery framework. Site specific management plans for the metapopulation sites will be appended as part of the plan. The planning process will involve local governments, non-profits, and interested and affected parties.

2. Evaluate and implement translocation where appropriate

Translocation or reintroduction of Karner blues will likely be used in several RUs to achieve recovery goals. Reintroduction to historical habitats lacking Karner blues may not be necessary for recovery (except possibly at TNC's Quincy Bluff and Wetland Preserve in the Glacial Lake Wisconsin RU). Translocation of Karner blues to unoccupied habitat within a developing metapopulation (with an extant Karner blue population) could enhance or accelerate the rangewide Karner blue recovery effort. Protocols and guidelines should be developed and refined to ensure that the translocation or reintroduction procedures are both appropriate and likely to be successful.

2.1 Develop protocols and guidelines for translocation

Before translocation of Karner blue butterflies occurs, the conditions necessary for ensuring metapopulation viability should be assessed. Moving butterflies in the absence of suitable or adequate habitat is not a wise use of resources. Before these relatively drastic measures are attempted, there should be a realistic expectation of long-term success based on the presence of adequate Karner blue

habitat, ongoing habitat management and restoration efforts, and the capacity for Karner blue/habitat management and monitoring. For example, factors causing the failure of the native population should be remedied prior to any translocation effort.

2.11 Develop protocols, guidelines, and selection criteria for translocation

Ecosystems or habitats identified as potential translocation sites should meet certain minimum habitat quality and management criteria. A protocol detailing the assessment of these minimum criteria needs to be developed to ensure that sites are suitable before actions are taken. This protocol will spell out the conditions under which Karner blue translocation is appropriate and should follow the habitat and buffering criteria outlined in PART II, RATIONALE, Buffering Capacity for viable populations (refer also to APPENDIX G). Methods for moving Karner blues to release sites should be determined. Evaluation of the Ohio DNR's Karner blue reintroduction program and the translocation efforts in Minnesota and New Hampshire will be helpful in the development of translocation protocols.

2.12 Incorporate research findings on captive propagation into protocols

As new ecological data are generated, and as experience with rearing protocols accumulates, timely refinements should be incorporated into the standardized captive propagation protocols. Evaluation of the Ohio DNR's Karner blue captive rearing program should be helpful in the development of captive propagation protocols.

2.2 Implement reintroduction or augmentation

Habitats in some RUs have declined to the point that Karner blue population persistence is very precarious. In these cases, short-term actions such as population augmentations and even re-introduction to reestablish subpopulations may be required to prevent metapopulation decline. Further, these tools may be useful for speeding recovery in a metapopulation, by increasing population densities and accelerating dispersal faster than might otherwise occur.

2.21 Initiate or continue captive rearing and augmentation

2.211 New Hampshire

Karner blue numbers in New Hampshire are precariously low. Captive rearing and release of adults to augment this site is ongoing and needs to be continued until population densities/levels increase to secure levels.

2.212 Minnesota

Karner blue numbers in Minnesota are precariously low. Captive rearing of adults and larvae (begun in 1999) to accelerate colonization to Lupine Valley should continue (refer to PART I, CONSERVATION MEASURES, Reintroduction/Translocation).

2.213 New York

Karner blue numbers in nearly all of the Glacial Lake Albany RU are precariously low. Captive rearing of adults to accelerate colonization to an unoccupied but apparently high-quality site may greatly increase metapopulation buffering and may increase the probability of Karner blue persistence in the state.

2.214 Other sites as need develops

If captive rearing/augmentation is determined to be an appropriate tool for use at other RUs, plans should be developed and implemented on an as needed basis.

2.22 Initiate captive propagation

Captive propagation involves producing Karner blue butterflies for release from a permanently captive breeding population. A portion of the progeny are released to the wild, while the population is maintained in captivity. This method should be used when large numbers of butterflies will be needed for release over a long period of time, or when a local population is in immediate danger of extinction.

2.221 New Hampshire

The Karner blue population in New Hampshire is precariously low. Captive propagation (the establishment of a permanent captive breeding population) appears necessary to ensure that this isolated population (with its potentially unique gene pool) is not lost before adequate habitat restoration is completed. A translocation project was started in New Hampshire in 2000 using Karner blues from New York (refer to PART I, CONSERVATION MEASURES, Reintroduction/Translocation). This does not preclude the need for captive propagation at this site.

2.222 Other sites as need develops

It is conceivable that populations in other RUs could decline to the point that local extinction is likely. If these populations are

genetically isolated, and real losses of genetic diversity or local ecotypes is eminent, then captive propagation should be considered.

2.23 Consider reintroduction if necessary

Some metapopulations recommended for recovery (refer to APPENDIX B, Table B1) may become extinct before habitat restoration efforts are complete (e.g., New Hampshire and Indiana), and reintroduction to these sites may be required. Reintroduction or introduction may be necessary at TNC's Quincy Bluff and Wetland Preserve property in the Glacial Lake Wisconsin RU once sufficient habitat has been restored.

3. Develop rangewide and regional management guidelines

While each metapopulation will have its own management and monitoring plan, some of the protocols and management practices can be standardized throughout the species range. The development of generic Karner blue guidelines will simplify RU-specific plan development.

3.1 Continue development of Karner blue butterfly Forest Management Guidelines

Several Karner blue populations occupy commercial and public forest lands such as Huron-Manistee NF in Michigan, and state and county forest lands in Wisconsin. Because much of the Karner blue butterfly landscape in the Midwest is forest land, it is important to understand the effects of forest management practices on the butterfly and its habitat and to be able to adjust these practices to conserve the butterfly. Forest Management Guidelines (Guidelines) for the Karner blue butterfly have been developed by Lane (1997). They are available from the Service's Green Bay Field Office (1015 Challenger Court, Green Bay, Wisconsin 54311) and should be updated as new information becomes available.

The Guidelines review various forest management operations (e.g., planting, harvesting, site preparation, and thinning) and identify what is known about the effects of these practices on the Karner blue butterfly and its habitat. In addition, the Guidelines identify how the practices could be compatible with, or enhance conservation of the butterfly (e.g., through the use of woods roads as dispersal corridors, or stand thinning to promote lupine persistence). They also identify research questions that need addressing to further assess the impact of forest management practices on the butterfly and its habitat. It is anticipated that the Guidelines would be used by landowners involved in managing forests and by wildlife managers; the guidelines may also assist private landowners in the development of habitat conservation plans.

3.2 Develop guidelines for protection of the Karner blue from biocides

Several Karner blue populations occupy commercial and public forest lands subject to broadcast or spot herbicide treatment, or gypsy moth control measures, or they occur near urban developments where mosquito control is an issue. In addition, some Karner blue sites are near agricultural fields where insecticide or herbicide application could affect the butterfly. Inappropriate use of insecticides and herbicides have the potential to extirpate or debilitate Karner blue populations. Thus, it is important to develop guidelines for the protection of the butterfly and essential components of its habitat (e.g., wild lupine and nectar plants) from pesticides. Pesticide protection guidelines should be incorporated into permits, management plans, and habitat conservation plans. Data from past and ongoing research efforts should be consulted during guideline formulation as should appropriate state administrative units.

Herbicides are used to control vegetation along roadways and utility corridors. Pesticide research, begun in 1995 on several herbicides used by the forestry industry in Wisconsin, examined the indirect impact of herbicides on lupine and selected nectar plants and the direct effects on egg survival and subsequent larval growth. Herbicides evaluated were various formulations of Accord, Oust and Garlon 4. The research found the herbicides applied late August or early September did not effect lupine abundance or flowering. Nectar plants showed a wide variety of responses depending on the species. Some species increased and some declined, but then gradually increased over time. The herbicides also showed little to no effect on hatching of Karner blue eggs, pupation of larvae or emergence of adults (Sucoff 1997, 1998). Pesticide use guidance developed from this research has been incorporated into the Wisconsin Statewide HCP for the Karner Blue Butterfly (WDNR 2000). It should be noted that herbicides are also used as tools for restoration of Karner blue habitat, sometimes via aerial or ground broadcast application, but more often through spot treatment of woody plants with Garlon 4 or Roundup.

Formulations of *Btk* (*Bacillus thuringiensis kurstaki*) are currently used in the Midwest for control of gypsy moth. The following guideline is currently recommended by the Service for *Btk*: No aircraft broadcasting of *Btk* should occur within one-half mile of any Karner blue butterfly sites. Distances of less than one-half mile may be acceptable on a case by case basis by building in precautions to minimize drift.

New York State DEC requires that aerial spraying of the mosquito adulticide Scourge remain outside of a 100 foot buffer area around occupied Karner blue butterfly sites in the Towns of Wilton and Northumberland in the Saratoga Sandplains and cannot take place when wind drift would make conforming to the requirement doubtful.

The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) has a landowner contact program designed to assist landowners, especially agricultural landowners, to avoid "take" of the Karner blue from pesticide applications, and is developing comprehensive pesticide use guidelines for the Karner blue. These guidelines should be finalized and updated as new information becomes available.

3.3 Continue development of Karner blue management guidelines

Several Karner blue RUs are centered on multi-use public and private lands, several of which are managed in part for wildlife production and hunting. Because many of these areas are important for the recovery of the Karner blue, it is important that land managers understand the impact of wildlife management practices on Karner blue populations and adjust accordingly given pre-existing constraints. Generic Karner blue management guidelines should provide overviews of current practices and suggest alternative practices when appropriate to minimize potential negative impacts from wildlife management. The WDNR has produced a set of wildlife management guidelines for the Karner blue (WDNR 1998) for use by its land manager and other interested parties. APPENDIX G provides management guidelines that should be revised as new information becomes available.

3.4 Continue development of standardized monitoring protocols for the Karner blue butterflies

Standardized monitoring protocols can be developed that could be applicable throughout the range of the species. Because monitoring needs will be different in each metapopulation, there is no need to use the same monitoring method throughout the range. Instead, a set of suitable, standard monitoring methods can be developed. Although this will not enable direct comparisons across the range, the monitoring systems will be refined to provide the best information to the local manager. Ongoing monitoring efforts in all RUs should serve as the starting point in development of these protocols (refer to APPENDIX H).

4. **Develop and implement information and education program**

The assistance of private landowners will be crucial for successful recovery in many RUs, including Merrimack/Nashua River System, Glacial Lake Albany, Newago, Muskegon, Indiana Dunes, Morainal Sands, and Glacial Lake Wisconsin, and possibly West Central Driftless, Wisconsin Escarpment/Sandstone Plateau, and Superior Outwash RUs. Private landowner participation in recovery is especially important in the Glacial Lake Albany RU where few sites are in public ownership, and even those sites may not have wildlife management as their primary goal (e.g., Saratoga County Airport).

In general, there will be three types of private landowners: (1) those whose primary goal is to be involved in recovery, (2) those who want to use their land for multiple purposes, and are willing to trade-off among these purposes, and (3) those who want to use their land for one dominant use that is not related to Karner blue conservation, which would include uses that are detrimental to Karner blue. The information and education programs may have several aims. For example, they can be used to assist the type (1) landowners, to encourage participation by type (2) and (3) landowners, and to diffuse potentially adverse public relations that might originate with some of the landowners. They can be used to recruit willing participants to meet identified recovery goals, or to identify willing participants who can assist in goal identification and planning on how to meet those goals. It will be important to allow private landowner to make their own decisions and determine the degree of participation in recovery they are willing to make. The information and education program can be useful for facilitating this process.

4.1 Develop outreach materials on Karner blue life history and conservation

In some portions of the Karner blue's range where the general public is aware and interested in the butterfly, there is little in the way of standardized information available to them. Information detailing the life history, habitat requirements, and habitat enhancement activities need to be developed and made available to public and private landowners. Educational materials on prescribed burning and the values of non-forest habitats (barrens and savannas) will be especially important for the Glacial Lake Albany and Glacial Lake Wisconsin RUs. Outreach materials and efforts should include reaching schools, scouting clubs, and gardening clubs (especially in the Glacial Lake Albany RU) whose interest in butterfly gardening may be helpful in efforts to improve habitat. A part of the planned Wilton Wildlife Preserve and Park in Saratoga Sandplains includes a visitor's center within the area of the metapopulation, which would inform visitors about the Karner blue and other species present in the local environment. The visitor's center will include a butterfly garden featuring some of the native species on which the Karner blue depends.

4.2 Inform local governments of Karner blue RUs

Because Karner blue populations often occur on locally owned public lands which are not necessarily managed for biodiversity, it will be vital to inform the local agencies that manage these lands about the Karner blue and its potential for occurrence on their lands. Developing effective partnerships with local governments (units smaller than the state) will help ensure that local land use decisions benefit Karner blue recovery.

4.3 Encourage private landowners to conserve the Karner blue butterfly

Provide educational/outreach materials, including management guidelines and recommendations, to private organizations and individuals to assist in the

development of their own Karner blue conservation initiatives. Work with local governments and private groups to develop informational and educational materials. Continue or initiate landowner contact programs to reach people in key habitat areas. Use existing Federal programs to encourage partnerships with private landowners and assist with financial costs associated with habitat restoration work. Federal programs that can provide landowner assistance are the Service's Partners for Wildlife Program, USDA's Natural Resource Conservation Service's Wildlife Habitat Incentive Program (WHIP), and the Farm Service Agency 's Conservation Reserve Enhancement Program (CREP). State stewardship and land management programs (e.g. Wisconsin) can also provide assistance. Existing and future environmental education centers, visitor's centers, etc., should be encouraged to become involved in education and outreach activities associated with the Karner blue butterfly.

4.4 Assess the needs, goals, and outcomes for public outreach

Although it is clear that public outreach programs are essential for recovery of the Karner blue butterfly, the goals of public outreach programs are often poorly defined. It is critical to define the needs, goals and outcomes of public outreach programs before substantial efforts are made. For example, development of an outreach program at IDNL could reach thousands of visitors per year and serve an important role in raising public awareness both locally in Indiana and nationally. An assessment of the best strategy to approach recovery at Miller Woods (Indiana) much of which is privately owned, will be needed. Assessing the best way to approach public outreach in the Glacial Lake Wisconsin RU (especially around Necedah NWR, Necedah Wildlife Management Area, and Sandhill WA) is crucial to support the recovery effort and savanna restorations in this RU. Support from the local communities, including forest owners and hunters, is essential.

5. Collect important ecological data on the Karner blue and associated habitats

Research is a crucial component of Karner blue recovery. Research activities that are necessary for successful Karner blue recovery are presented below. Table 5 includes a summary of research that the Recovery Team deemed interesting but not necessary for Karner blue recovery.

It is envisioned that research would be conducted by one or more agencies and other partners if available. Federal agencies that may assist with research include the Service, U.S. Geological Survey, NF Service, Department of Defense (e.g. Fort McCoy), and the Federal Aviation Administration. State agencies anticipated to assist include the state DNRs (or DEC in NY) and Natural Heritage Programs in states where Karner blues occur. Other parties that may assist with research tasks include partners to the Wisconsin Statewide HCP such as County Forest Departments, industrial forest landowners, and other private companies. Assistance from various universities and private landowners is also anticipated.

5.1 Priority 1 Research

5.11 Habitat management relative to the Karner blue butterfly

Determine the effects of habitat management on Karner blue butterfly populations and identify how to implement beneficial management practices to conserve or improve butterfly populations for application in the Glacial Lake Albany (New York), Merrimack-Nashua (New Hampshire), and Paleozoic Plateau (Minnesota) RUs where populations are severely declining or at risk of loss. This research should focus on: (a) developing methods to improve the habitat of occupied sites while avoiding or minimizing harm to Karner blue, and (b) developing methods to increase the size of suitable sites and promote rapid (1-2 years) colonization.

5.12 Methods development for the Karner blue captive propagation

Develop methods for captive propagation of the Karner blue butterfly for application to the Concord population which is at risk of loss. Methods development should be done using Karner blues, not model systems.

5.13 Lupine propagation

Determine how to grow lupine from seed and to establish and maintain large populations of lupine and nectar plants efficiently, especially in the Glacial Lake Albany (New York) and Merrimack-Nashua (New Hampshire) RUs where populations are declining or may be lost.

5.14 Karner blue translocation methods

Develop methods for translocation of Karner blue butterflies, focusing especially on release methods and methods to evaluate the impact of these releases on Karner blue butterfly abundance. This research is especially crucial for application at sites with declining butterfly populations.

5.15 Alternative habitat restoration methods

Develop habitat restoration techniques, in addition to fire, that improve Karner blue populations. These techniques may include mowing, cultivating, and applying herbicides to control woody growth.

5.16 Remote sensing

Develop remote sensing capabilities to identify lupine sites especially for the Muskegon and Newago RUs which are large landscapes that could be losing populations that are yet unknown.

5.17 Glacial Lake Albany metapopulation decline

Determine the causes of Karner blue decline in the Glacial Lake Albany RU and how to mitigate them. This is critical in this RU because of low population numbers at most sites, and potential for the loss of some sites.

5.2 Priority 2 Research

5.21 Karner blue dispersal

Conduct research on the population structure of the Karner blue, especially focusing on dispersal rates in relation to distance between lupine sites, area of lupine sites, and the spatial distribution of the sites. Work is needed in open habitats, savanna/barrens habitat, and especially in forested and urban-suburban habitats.

5.22 Dispersal corridors and barriers

Determine factors necessary to create dispersal corridors and the factors that comprise dispersal barriers.

5.23 Ecosystem management

Develop methods for improving or restoring ecosystems that are compatible with the Karner blue butterfly.

5.24 Karner blue monitoring

Develop and verify cost-effective and statistically reliable methods for monitoring the Karner blue butterfly.

5.25 Forest management research

Determine the effects of forest management practices on the Karner blue and identify how to implement beneficial management practices to conserve or improve populations. Work is needed in all relevant forestry environments, especially red pine. Three specific research topics are:

(a) What is the economic cost of reducing stand density to create or support Karner blue habitat? Emphasis should be on evaluating the effects of various levels of canopy reduction, in relation to tree basal area, productivity and Karner blue populations.

(b) What are the effects of clear cutting and site preparation on the Karner blue and its habitat? Emphasis should be on what happens during conversion from hardwood to pine, and on comparing site preparation methods, including chemical site preparation and

planting, amount of surface disturbance for site preparation (low/medium/high), and use of prescribed fire (feasibility and effects).

(c) What are the effects of clearcut without conversion? Emphasis should be on determining when such clearcuts occur and the influence of the season of harvest (e.g., growing season versus dormant season and frozen versus unfrozen ground).

5.26 Highly dispersed metapopulations

Develop management practices for aggregations of occupied sites that are highly dispersed geographically (many sites greater than one mile from the next nearest site), so that they can be managed as a viable metapopulation (e.g., in the Superior Outwash or Morainal Sands RU).

5.3 Priority 3 Research

5.31 Ecology of local populations

Determine the relation between habitat structure and Karner blue butterfly populations. This entails a complex set of research issues, which may include: (a) determine why some sites support extremely high densities of the Karner blue (e.g., the Crossgates Mall site and numerous sites in the western part of the species range); (b) determine how the butterflies react behaviorally to their habitat; (c) evaluate oviposition preference of Karner blue butterfly in relation to lupine quality and its implications for Karner blue; (d) investigate the nutritional ecology of larvae feeding on lupine and the relation to reproductive state and growing conditions; (e) develop a better understanding of the role of ants in Karner blue butterfly populations; and (f) determine the relation between nectar availability and female fecundity. It is not possible to anticipate all of the needed information on the ecology of local populations that is necessary for recovery. Thus, it is essential that proposed research in this area clearly identify why the research is necessary for recovery.

5.32 Effects of human activities

Determine how management and human use of rights-of-way influence the Karner blue butterfly (positively and negatively), especially in those areas where rights-of-way are essential for recovery. Assess how to develop positive interactions with people to enlist their support in developing and maintaining butterfly habitat.

5.33 Browse thresholds

Determine browsing thresholds on lupine by deer and woodchucks that present significant problems to persistence of lupine and acceptable Karner blue habitat in New Hampshire, New York, and Minnesota.

5.34 Re-establishment of lupine

Determine how lupine re-establishes on sites where a tree canopy has been opened and where lupine was not known to occur before the canopy was opened by evaluating the relative importance of a seed pool, rootstock survival, and recolonization. Determine how fire, light regime, and soil moisture interact to affect lupine abundance over successional time scales. This research should be designed to be directly applicable to those areas where lupine establishment has been problematic (e.g., the Albany Pine Bush).

5.35 Population structure

Determine actual/potential Karner blue metapopulation structure at highly fragmented sites to project how these metapopulations may persist as viable metapopulations, focusing on metapopulations in the Merrimack/Nashua River System RU, the Glacial Lake Albany RU, the Ionia RU, West Gary in the Indiana Dunes RU, and the Morainal Sands RU.

6. Review and track recovery progress

6.1 Develop a clearinghouse for Karner blue data, progress reports, metapopulation plans, HCPs, guidance documents, and other relevant information

Easy access to relevant Karner blue information will be essential for success of the Karner blue recovery process. A single collection and distribution point, with a commitment to providing relevant planning and educational materials will streamline this process and will facilitate Karner blue recovery. Currently, the Service's Green Bay Field Office in Wisconsin is maintaining a collection of research and outreach materials related to the Karner blue.

6.2 Conduct Recovery Team meetings on an annual basis to evaluate progress

Successful recovery of the Karner blue will require adaptive management and oversight. Annual meetings of the Recovery Team and interested parties will allow the Team members to review progress, learn of new research, discuss unanticipated developments, revise strategies, revise guidance documents and adjust priorities on an as needed basis. This would help ensure that Karner blue

recovery stays on track. Meetings should start one year after publication of the final Approved Recovery Plan.

6.3 Revise Plan as appropriate at five-year intervals

The Karner Blue Butterfly Recovery Plan can not address every future development and contingency. As such, it will likely need to be revised/updated at regular intervals to better reflect current conditions, and incorporate new research findings.

6.4 Hold periodic meetings to promote information sharing

Sharing information on Karner blue research, habitat management techniques, monitoring, and adaptive management efforts in a forum that allows for discussion, problem solving, and assessment of effectiveness is important to recovery. Recovery partners and other interested parties including private land owning stakeholders should be involved. These meetings could be held when sufficient information has accumulated, but no more often than every 3-5 years.

Table 5. Research that is NOT a priority for recovery.

I. GENETIC STRUCTURE

1. Determine the genetic structure of the Karner blue butterfly range wide.
2. Evaluate the genetic relatedness of Glacial Lake Albany and Merrimack-Nashua populations of the Karner blue butterfly.

Research on genetic structure of the Karner blue is considered unnecessary for recovery of the species. While recognizing that this information could be useful in translocation efforts, the current translocation guidelines (APPENDIX I) provide sufficient guidance for these efforts at this time.

One of the fundamental assumptions of the recovery strategy is that RUs will preserve geographic genetic variation. Genetic studies would enable this assumption to be tested. Although such a test would be beneficial, in an ideal situation, it is doubtful that information on genetic structure would change the recovery strategy. A negative result is difficult to prove, and it would take considerable resources and time to compile a convincing case that Karner blue populations are not genetically structured. Moreover, even if the negative result could be adequately supported, it is only one of several assumptions underlying the recovery strategy. It would be more expedient to use the limited resources and time to recover the species. A positive result would verify the assumption but would not change the recovery strategy.

One of the greatest needs for genetic study is determining if the New Hampshire population is genetically distinct from the New York populations. Unfortunately, there are so few individuals left in the New Hampshire population, that the increased risk to the population from such a genetic study is intolerable. However use of existing specimens for such a study would be acceptable.

II. DEFINITION OF A VIABLE POPULATION

1. Determine if 3,000 butterflies are too few or too many to have a VP.
2. Determine if the Saratoga Airport is truly a viable population.

While the Recovery Team recognizes that the 3,000 butterfly reclassification level for a minimum VP can be criticized, it is a reasonable working hypothesis on which to base recovery. Moreover, it is doubtful that research on this issue would change the recovery strategy in any major way. For example, such research could demonstrate that the reclassification criterion is high or low by 600 or more butterflies. This Plan already provides flexibility for this criterion and provides guidance for when the criterion is likely to be too high or too low (refer to APPENDIX E). Thus, research on this issue is not necessary for recovery.

Although there is some controversy about whether the Saratoga Airport population is a viable population, it is widely recognized that expansion of that population into nearby habitat is needed and would buffer the population against any disaster that might occur at the airport. Because current efforts are to expand this population into nearby habitats, the issue is probably moot.

III. OTHER RESEARCH TOPICS

1. Determine the impact of armed forces training activities on the Karner blue butterfly (includes vehicle traffic and bombing practice).
2. Determine the significance of predation on Karner blue viability.

Although both of these research topics are significant, neither is considered a priority for recovery as research goals. Armed forces training activities are likely to play a significant role in the management of Karner blue populations at Fort McCoy, Wisconsin by maintaining disturbance regimes, and therefore are a low priority for research. However research to improve management of Karner blue populations at this location may be necessary. Moreover, Fort McCoy will probably continue to be an excellent location for conducting research that is necessary for recovery and applicable to other parts of the species range. In a similar way, research on predation will probably become necessary in some part of the species range, but a research project aimed at determining the significance of predation would be a misplaced effort.

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